



**Picture 1. View NE from Cleveland Ave. across mowed wildflower area, former Uniontown Tire.**



**Picture 2. Inside fence near MW-1 (looking southeast) showing forested island beyond "grassland".**





**Picture 3. Same location as Picture 2, looking south along mowed path.**



**Picture 4. Same location as Picture 2, but looking east beyond another island to open grassland.**





**Picture 5. Just north of Picture 3 location, looking east toward forested island.**



**Picture 6. Same location as P5, but looking northeast across ~20' of grass toward island.**





**Picture 7. East of the forested island in P4, looking NE across grassland.**



**Picture 8. Same location as P7 but looking north. Trees emerging but few shrubs**





**Picture 9.** 100 yards north of Picture 8, looking west. Trees but few shrubs in island.



**Picture 10.** Same location as Picture 9 but looking east. Island w/trees and few shrubs.





**Picture 11. Same location as P9 and P10, looking NE toward emerging forested islands.**



**Picture 12. Emerging forested island: trees, few shrubs.**





**Picture 13. More-established island; some shrubs.**



**Picture 14. MVS pipeline and mowed area for access.**





**Picture 15. Lower-lying “grassland areas” have thick wildflower and similar vegetation.**



**Picture 16. Photo from MVS looking west; when mowed, can easily see across Cleveland Avenue.**







**Industrial Excess Landfill (IEL) Site (Site)**  
**Remedial Action Contingency Plan for Groundwater Monitoring**  
**September 22, 2003**

This Remedial Action Contingency Plan (Contingency Plan) has been developed to describe the approach that The Responding Companies (Bridgestone/Firestone, Inc., BFGoodrich Company, The Goodyear Tire & Rubber Company, and GenCorp) will take to address any threat of an exceedance of remedial performance standards established for the Industrial Excess Landfill (IEL) Site (Site). The performance standard established as part of the remedial action(s) to be undertaken at the site is:

- No unacceptable threat to human health or the environment as a result of exposure to constituents that have migrated from the Site.

The principal potentially-complete exposure pathway is via migration through groundwater. As a result, the Responding Companies have instituted a groundwater monitoring program to ensure that affected groundwater from the Site does not pose any unacceptable threat. The potential for any completed groundwater exposure pathway is low because downgradient residents are all using the public water supply. In addition, groundwater downgradient from the Site has not been shown to be affected by migration of constituents from IEL.

In addressing groundwater issues, there are Remedial Action Objectives (RAOs) for the site, as follows:

1. No off-site downgradient well shall contain IEL-Site-related Constituents of Concern (COCs) at levels that exceed the respective USEPA Drinking Water Standard Maximum Contaminant Level (MCL); and
2. No monitoring well in the IEL network shall contain IEL-Site related COCs at levels that exceed MCLs.

Once these RAOs are met and shown to be likely to persist, the remedial action should be considered to be complete.

The groundwater-monitoring program is designed to monitor the groundwater to document progress toward meeting Site RAOs. This Contingency Plan is designed to describe how The Responding Companies will address any threat of an exceedance of the remedy performance standard or address groundwater quality trends that suggest problems in eventually meeting Site RAOs.

### ***Introduction***

Long-term monitoring of the groundwater in the vicinity of Industrial Excess Landfill Site shall continue until at least 2033 or until three consecutive sampling events (conducted no less frequently than annually) demonstrate continued attainment of Site Remedial Action Objectives. The intensity of this monitoring will depend, in part, upon the results of the monitoring program.



Should any groundwater monitoring show a threat of an exceedance of Site performance standards, the Responding Companies shall implement the Remedial Action Contingency Plan described herein. A threat of an exceedance of the performance standard is defined as:

- A statistically-significant increasing trend of any Site COC in any On-Site Well, Sentinel Well, or off-site Downgradient Well with concentrations greater than the respective MCL. This increasing trend (at >MCL) has the potential to eventually migrate off-site to beyond the homes supplied with public water.

### ***Remedial Performance Standard***

The Remedial Performance Standard for the IEL site is to protect human health and the environment from risks resulting from exposure to COCs from the IEL Site. This standard has already been achieved. As part of the remedy implementation, a groundwater-monitoring program is being established to verify that this protectiveness is maintained.

Under current site-use scenarios, the only plausible source of a threat to human health or the environment is via a groundwater pathway as demonstrated by previous investigations and a risk assessment. Should any additional investigation (e.g., methane investigation) identify the potential for exposure via any other pathway, Remedial Performance Standards shall be developed to address this potential and the Contingency Plan shall be expanded to incorporate monitoring for any additional RAOs.

In the absence of any change to the site use or any newly-identified threat to exposure, groundwater monitoring shall be sufficient to verify that the IEL remedy remains protective of human health and the environment. Any change to the site use shall be evaluated to determine whether that change has the potential to cause completion of any other exposure pathway.

### ***Contingency Plan***

Five year statutory reviews under Section 121(c) of CERCLA, 42 U.S.C 962(c) are required as long as hazardous substances remain on-site and prevent unrestricted use of the Site to assure that the remedy continues to be protective of human health and the environment. In addition to the 5-year reviews, The Responding Companies will implement a groundwater-monitoring program, as detailed in the Remedial Design Plan for the Site.

Should the results of analyses of samples from any of the wells show Site COC concentrations that exceed MCLs, the following response action process shall be initiated:

#### **Step 1: Evaluate Whether There is a Statistically-Significant Increasing Trend**

Within 45 days of receipt of final laboratory results that show an exceedance of an MCL, that result shall be subjected to an evaluation to determine whether there is a statistically significant



increasing concentration trend in that well according to the Mann-Kendall statistical treatment (or approved equivalent). If there is no increasing trend, no further action will be required.

If an increasing trend is found, the trend information shall be evaluated to determine whether the increasing trend results from migration of that COC from the IEL Site. The Responding Companies shall present the results of its evaluation to the USEPA. If the USEPA is convinced that a given exceedance is not evidence of an increasing trend due to migration from the IEL Site or that the exceedance does not pose a threat to human health or the environment, then no further action shall be required.

However, if the USEPA believes that the test results may be evidence of an increasing trend, then the well with the MCL exceedance shall be resampled / reanalyzed for the parameter(s) that exceed(s) the MCL (at a minimum) within 45 days of the USEPA's completion of their review of the exceedance evaluation. The Responding Companies will sample any other wells and analyze for any other parameters they believe are needed to identify the reason(s) for any MCL exceedance / increasing concentration trend. Re-sampling can be waived only if both the Responding Companies and the USEPA agree that a re-sample is not necessary.

## **Step 2: Exposure Pathway Analysis**

If the re-sample result, when added to the Mann-Kendall statistical analysis, still identifies an increasing trend, the level of the exceedance shall be reviewed and analyzed (within 45 days) with respect to historical data to determine whether the exceedance has the potential to cause an off-site, downgradient (Tier D) monitoring well to exceed an MCL within the next calendar quarter. The results of the exposure pathway analysis shall be summarized and submitted in writing to the USEPA. Unless the USEPA is convinced that there is no realistic potential for exposure within one calendar quarter, the nearest downgradient wells shall be sampled / analyzed (within 45 days of completion of the Trustees' review of the exposure pathway analysis) and Step 3 of the contingency plan shall be initiated.

## **Step 3: Initiation of a Groundwater Response Plan**

The Responding Companies shall develop and submit for USEPA approval, a response plan to identify an appropriate response to ensure mitigation of any exposure via a groundwater pathway and continued protection of the human health and the environment. The groundwater response plan consists of the following components, undertaken in a timely fashion to ensure protection of human health and the environment:

- Evaluation of the need for an Immediate Response (30 days)
- Focused Feasibility Study (FFS) (60 days),
- Focused Remedial Design (FRD) (60 days), and
- Focused Remedial Action (FRA) (60 days).



The Response Plan shall describe how to evaluate (within 30 days of initiating Step 3) whether there is a need for any immediate response to protect human health or the environment. An example of an immediate groundwater response option is the provision of an alternative water supply as necessary to address immediately-downgradient receptors at risk of exposure to groundwater affected by IEL. Other immediate response actions shall be evaluated as necessary to address the particular conditions detected at (and downgradient from) the Site. They may be implemented at any time during the process.

In Step 3, the Responding Companies shall conduct a Focused Feasibility Study to determine the best approach to mitigating the impacts of the detected exceedance of Site RAOs. This FFS shall include a review of relevant data including the results of the sampling of Tier D wells described in Step 2 to support the conceptual remedial design of potential remedies of the exceedance.

Based on the results of the FFS, the Responding Companies shall complete the Focused Remedial Design and implement the Focused Remedial Action.

### *Plan Implementation / Methodology*

As part of the Remedial Design Plan, The Responding Companies will implement a groundwater-monitoring plan through 2033. Wells may be removed from the monitoring well network if they show no detections of Site COCs for three consecutive sampling events. In evaluating results of the monitoring, The Responding Companies may use statistical methods that are consistent with the following documents:

- Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, New York (Gilbert, 1997)
- Methods for Evaluating the Attainment of Cleanup Standards: Volume 2: Groundwater (USEPA, 1992)
- The Lognormal Distribution in Environmental Applications (USEPA-ORD-OSWER, 1997)

At any time throughout the planned monitoring program, The Responding Companies may meet with the USEPA to develop mutually-acceptable modifications to the program that better-document achievement of Site performance standards or RAOs.

As described above, a threat of an exceedance of the IEL Site performance standard is defined as a statistically-significant increasing trend of an IEL-Site COC due to migration from IEL at a level that exceeds its MCL and has the potential to cause an off-site downgradient well to exceed an MCL. There are several possible sources of an MCL exceedance that are not related to migration from the IEL Site. These may include:

- Inadvertent contamination by common lab contaminants (acetone, methylene chloride, etc.);
- Naturally-occurring constituents (metals) that cause an MCL exceedance at a downgradient well that doesn't have a similar exceedance at a well located between the subject well and IEL;



- Non-IEL Site sources of constituents (pesticides/herbicides from agricultural activities, septic system sources, etc.); and
- Other sampling anomalies (sporadic detections of constituents that are not duplicated).

The determination of what may not be related to migration from the IEL Site must be demonstrated to the reasonable satisfaction of the USEPA. Irrespective of potential non-IEL sources, all data collected using low-flow techniques shall be used in a Mann-Kendall statistical evaluation of any MCL exceedance to identify whether there is an increasing trend for that constituent in that well. Typically, once sufficient data are collected from each well, most of the above-listed non-IEL events shall be shown to not result in a statistically-significant increasing trend.

The Mann-Kendall evaluation is a nonparametric test for trend that does not require any particular data distribution, allows missing values, and can incorporate non-detect results. The Mann-Kendall test uses relative magnitudes of the data in a nonparametric test for zero slope of the linear regression of time-ordered data versus time. The Responding Companies shall use the Mann-Kendall test with all data (non-detectable results shall be included at the method detection limit) generated from low-flow testing. In addition, The Responding Companies shall also use data collected by other sampling techniques to the extent that these data are representative of site groundwater conditions. Any report on a Mann-Kendall evaluation shall describe the range of the data set evaluated.







# INDUSTRIAL EXCESS LANDFILL (IEL) SUPERFUND SITE (SITE)

## DRAFT EXPLOSIVE GAS INVESTIGATION FOR THE EASTERN FACILITY BOUNDARY

### 1 INTRODUCTION

The Industrial Excess Landfill (IEL) Site located in Uniontown, Ohio, is being addressed in accordance with a Record of Decision (ROD) that requires investigation of the potential for migration of explosive gases, including methane and non-methane hydrocarbons. Previous site remedial investigations and remedial actions included the installation of landfill gas monitoring wells, passive landfill gas vents, and an active methane venting system (MVS). The landfill gas investigations and monitoring, and the MVS installed at the site, focused on the north, south, and west facility boundaries while excluding the eastern facility boundary, in-part because there are no near-site receptors, and in-part because of the topography of the site. The purpose of this investigation is to provide a method to evaluate potential landfill gas migration at the eastern facility boundary.

### 2 SITE GEOLOGY

The site is a former sand and gravel pit operation that was used as a landfill after mining operations ceased. Waste materials were landfilled at the site from approximately 1966 through 1978. The Carlisle Muck soil series (Summit County Soil Survey, 1971) borders the entire eastern facility boundary. The Carlisle Muck soil series is characterized as 0 – 9 inches of muck, 9 – 22 inches of dark reddish-brown muck and partially decomposed peat, and 22 to 60 inches of dark yellowish-brown partly decomposed peat. Depth to the underlying mineral layer (sands, gravels, silts) ranges from 5 feet to 30 feet or more. The Carlisle Muck likely provides an effective barrier to gas migration from the site to the east. Additionally, the eastern facility boundary is bounded by Metzger Ditch. The water elevation in Metzger Ditch is also an effective barrier to gas migration to the east. Figure 1 shows the location of the Carlisle Muck and Metzger Ditch.

The depth of landfilled material averages 20 feet to 30 feet. The shallow water table elevation is about 1120 MSL and wets part of the landfill waste. Soils under the landfill include sand and gravel lenses, silts, silty-sands, and clayey-sands. Figure 2 provides a cross-section of the site.

### 3 METHANE MIGRATION PREDICTION

The theoretical migration distance from the edge of placed waste on the eastern facility boundary was calculated using *RCRA RFI Guidance Volume II, Appendix D*. This model allows migration prediction for the methane 100% Lower Explosive Limit (LEL) and the methane 25% LEL. The prediction model uses the age of the landfill, average waste thickness, geology, climate, and natural barriers to migration to provide a “corrected” distance to the 100% LEL and 25% LEL. The predicted migration distances are plotted on Figure 1. This prediction assumes a



homogenous site without the topographic relief or the presence of the Carlisle Muck and Metzger's Ditch.

The proximity of the Carlisle Muck and Metzger's Ditch at the eastern facility boundary, and the ability for any gas generated in the waste to outgas at the downslope face makes gas migration past this point unlikely. However, to confirm these evaluations, the following investigation is planned.

#### **4 OUTLINE OF GAS MIGRATION INVESTIGATION**

- Place five temporary monitoring points along the eastern facility boundary as shown in Figure 1. Note that these points will likely be located in the Carlisle Muck.
- Place two temporary monitoring points off site and in the Carlisle Muck series to determine background methane levels in the associated peat/organic material.
- Depth of the temporary monitoring points shall be to 6 feet or to groundwater whichever is encountered first.
- A gas sample will be extracted from the temporary monitoring point using a sampling pump connected to an onsite landfill gas analyzer (such as Lantec).
- The gas sample will be analyzed for methane, carbon dioxide, and oxygen. The analyzer shall also be capable of measuring static pressure.
- Prior to implementing the investigation, a sampling and analysis plan will be provided detailing construction methods, sampling protocol, analysis, data validation, and quality assurance and control.

#### **5 DATA USAGE**

- Background methane concentrations taken in the offsite Carlisle Muck will be compared to the onsite methane concentrations. Onsite methane concentrations will be adjusted accordingly.
- If the gas threshold limit is 100% of the LEL in any of the temporary onsite monitoring points, those points will be re-sampled to verify the results.
- Data from the initial monitoring will be used to establish the need for permanent and/or additional monitoring points.



CROSS SECTION A-A



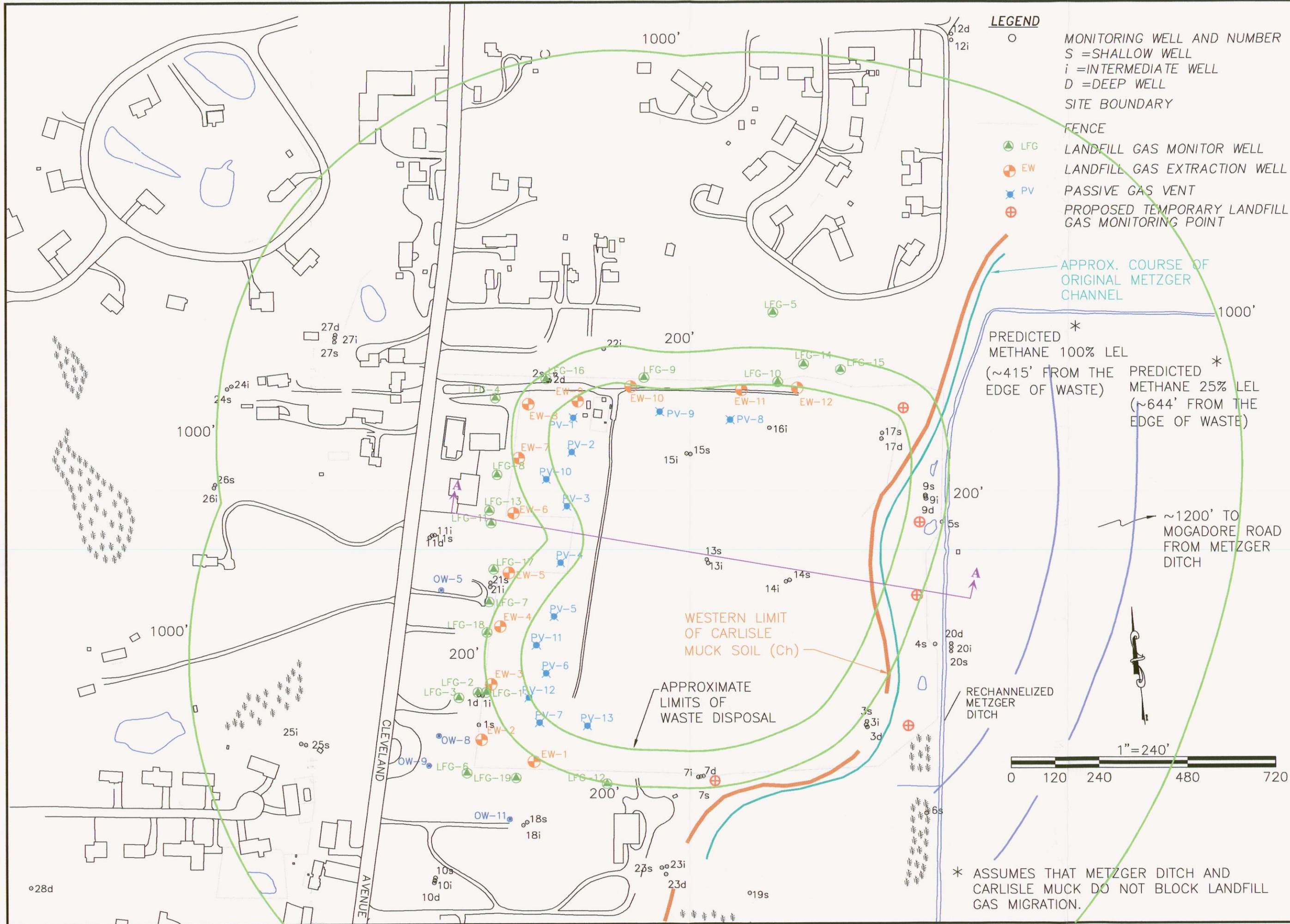
REFERENCES

- X-SECTION 8+00 TAKEN FROM TETRATECH PLAN SHEET 13/37
- GEOLOGY FROM BORING LOGS PERFORMED BY C.C. JOHNSON & MALHOTRA AND GERAGHTY & MILLER
- DEPTH OF LANDFILL MATERIAL FROM BORING LOGS AND ESC, INC. DRAWING 5/5/97
- HORIZONTAL EXTENT OF CARLISLE MUCK FROM SOIL SURVEY, STARK COUNTY, OHIO 1971

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Project Reference: 7203

IEL LANDFILL  
PROPOSED LANDFILL GAS MONITORING  
EASTERN FACILITY BOUNDARY

FIGURE 1

Client: IEL PRP GROUP

**SHARP**  
AND ASSOCIATES, INC.  
982 CRUPPER AVE.  
COLUMBUS, OHIO 43229  
(614) 841-4650 / FAX (614) 841-4660





## **IEL DRAFT REMEDY CONSTRUCTION SPECIFICATION**

### ***Outline of anticipated tasks:***

The planned implementation of the remedy for the Industrial Excess Landfill (IEL) Superfund Site (Site) includes the following construction activities / scope to be performed prior to December 2004:

1. Fence repair and signage.
  - Approximately 300 linear feet of 5'-high chain link fence requires repair;
  - 4 signs need to be prepared;
2. Debris removal and disposal.
  - Miscellaneous debris shall be removed as found. Majority of debris associated with landfill gas operation.
3. Rework of the groundwater monitoring well network.
  - Properly abandon 10 on-site wells in accordance with a to be developed and approved work plan,
  - Properly abandon 23 off-site wells in accordance with a to be developed and approved work plan,
  - Properly abandon 6 "observation wells" remaining from USEPA demolition activities in accordance with a to be developed and approved work plan,
  - Install 5 new/replacement wells on site in accordance with a to be developed and approved work plan,
4. Design a program for vegetative cover enhancement and management for habitat diversity.
  - Review Site conditions, WHC, ANS, CAG, and other site reports.
  - Coordinate with CAG.
  - Identify any enhancements or site management activities needed to accelerate the current pace of revegetation, as necessary.
  - Identify needed repair of bare spots.
5. Implement vegetative cover enhancements and habitat diversity activities
  - Plant vegetation: trees, shrubs, switch grass, hedgerow, wildflowers.
  - Rotational mowing for edge environments.
  - Invasive species removal.
  - Habitat enhancements: nest boxes, fox dens, raptor perches, brush piles.

*DRAFT* IEL REMEDY CONSTRUCTION SPECIFICATION

Division 1  
**GENERAL REQUIREMENTS**

**INDEX TO GENERAL REQUIREMENTS**

- 1.0 SUMMARY
  - 2.0 PRICE AND PAYMENT PROCEDURES
  - 3.0 SCHEDULE
  - 4.0 HEALTH AND SAFETY
  - 5.0 QUALITY ASSURANCE
  - 6.0 TEMPORARY FACILITIES AND CONTROLS
- EXHIBIT 1 – PRICING SCHEDULE



## **1.0 SUMMARY**

The Industrial Excess Landfill (IEL) Superfund Site (Site) is located in Uniontown, Ohio. In 1980, the site was covered with a sandy loam soil cap nominally two (2) feet in depth. Central portions of the site have begun succession to forest. The purpose of this project is to:

- Maintain site security by fence repair and signage improvements;
- Remove debris and dispose;
- Modify the monitoring well network;
- Enhance the habitat and aesthetic values of the site through planting of trees, shrubs, and grasses and the installation of nesting and cover structures.

## **2.0 PRICE AND PAYMENT PROCEDURES**

Pricing and payment shall be in accordance with Exhibit 1. Payment shall be made within thirty (30) days of invoice approval by the Engineer. Invoices may be submitted upon completion of each pay item listed in Exhibit 1.

## **3.0 SCHEDULE**

All work, with the exception of the maintenance period, shall be complete within six (6) months of award. Contractor will note date-specific planting restrictions contained in Division 2, Technical Specifications.

Contractor shall provide a gantt chart schedule with the bid. This schedule will be considered in making the Award and will be incorporated into the contract.

## **4.0 HEALTH AND SAFETY**

All site personnel must have current be HAZWOPER training per 29 CFR 1910.120. Certificates of training must be provided to the engineer prior to site entry. Level D personal protective equipment (PPE) is anticipated for all project activities.

Contractor shall stop work and notify the Engineer immediately if unexpected conditions are encountered. *Over excavation, resulting in the exposure of waste and resultant work stoppages, and remediation and disposal costs shall be Contractor's responsibility.*

Contractor shall prepare a Project Health and Safety Plan for review by the Engineer prior to initiation of work.

## **5.0 QUALITY ASSURANCE**

**To be completed**

## 6.0 TEMPORARY FACILITIES AND CONTROLS

Contractor shall provide all temporary facilities required for completion of the work. Contractor may locate a break / office trailer at the site. The location of the trailer must be approved by the Engineer.

Power and water are unavailable at the site. Contractor shall provide water required for planting and maintaining vegetation. Contractor shall install and maintain silt fence and other erosion control measures as required to protect surface waters.

## 7.0 PRICING SCHEDULE

Estimated quantities and pricing requirements are detailed in Exhibit 1.

### EXHIBIT 1 PRICING SCHEDULE

#### BASE BID

Item	Unit	Quantity*	Unit Price	Extension
Repair fence (300')	ls	1		
Design/install 4 signs	ls	1		
Remove debris	ls	1		
Abandon wells 10 on-site wells 29 off-landfill wells	ls	1		
Install wells (5)	ls	1		
<b>Habitat Enhancements</b>				
Bird Nesting Box	ea	10	\$	\$
Fox Den	ea	1	\$	\$
Bat Box	ea	3	\$	\$
Raptor Perch	ea	3	\$	\$
Brush Pile	ea	5	\$	\$
Rock Piles	ea	4	\$	\$
Wildflower Meadow	ac	1.5	\$	\$
Hummingbird Garden	ac	0.125	\$	\$
Forested Islands	ac	4.5	\$	\$
Hedgerow Enhancement	ac	1.675	\$	\$
Switch Grass Border	ac	1.5		
Invasive Species Removal	ea plant	50	\$	\$
Site Restoration	ls	1	\$	\$
Site Maintenance	month	0-3	\$	\$
Mobilization	ls	1	\$	\$
Demobilization	ls	1	\$	\$
<b>TOTAL</b>			\$	\$

Habitat enhancement quantities are estimated at the median. Example, 0-20 bird nesting boxes will be installed; the quantity is = 10.



**SUPPLEMENTAL UNIT PRICING**

Item	Unit Price
Hybrid Poplar Pole, planted	\$
Northern Red Oak, planted	\$
Shrub (any listed specie as directed), planted	\$
Switch Grass, planted per 1000 square feet	\$
Reserved	\$
Reserved	\$

# **IEL HABITAT ENHANCEMENT PROJECT**

## **Division 2**

### **TECHNICAL SPECIFICATIONS**

#### **INDEX TO SPECIFICATIONS**

- 1.0 BIRD NESTING BOXES
- 2.0 FOX DENS
- 3.0 BAT BOXES
- 4.0 RAPTOR PERCHES
- 5.0 BRUSH PILES
- 6.0 ROCK PILES
- 7.0 WILDFLOWER MEADOWS
- 8.0 HUMMINGBIRD GARDEN
- 9.0 FORESTED ISLANDS
- 10.0 HEDGEROW ENHANCEMENT
- 11.0 REMOVAL OF INVASIVE SPECIES
- 12.0 SITE RESTORATION
- 13.0 SITE MAINTENANCE



## **2.0 BIRD NESTING BOXES**

- 2.1 Bird nesting boxes generally shall be located as shown on Sheet \_\_\_\_\_. Actual field locations shall be approved by the Engineer prior to installation.
- 2.2 Contractor shall provide all labor, equipment, and materials required for fabrication and installation of the nesting boxes.
- 2.3 Any variation in design or materials of construction shall be approved by the engineer.
- 2.4 A sample box and mounting pole of each type listed in the Nesting Box Schedule shall be provided to the engineer for approval. Once approved, the box and pole will be returned to the Contractor.
- 2.5 The Nesting Box Schedule is shown on Sheet \_\_\_\_\_.
- 2.6 Typical drawings for each nesting box type are shown on Figures 4 and 5.
- 2.7 Pole installation details are shown on Sheet \_\_\_\_\_.
- 2.8 Contractor shall protect existing vegetation from damage during installation of nesting boxes, except as provided in Section 11.

## **3.0 FOX DENS**

- 3.1 Two (2) fox dens generally shall be located as shown on Sheet \_\_\_\_\_. The actual field locations shall be approved by the Engineer prior to installation.
- 3.2 Contractor shall provide all labor, equipment, and materials required for fabrication and installation of the fox dens.
- 3.3 Any variation in design or materials of construction shall be approved by the engineer.
- 3.4 Materials of construction shall be approved by the engineer.
- 3.5 Typical drawings for each fox den are shown on Figure 6.
- 3.6 Contractor shall construct an earthen mound over each den, as provided on Sheet \_\_\_\_\_. Contractor shall limit subsurface excavation to no more than one (1) foot below existing ground surface. Contractor shall seed the mound per Section \_\_\_\_\_.
- 3.7 Contractor shall protect existing vegetation from damage during installation of fox dens, except as provided in Section 11.

## **4.0 BAT BOXES**

- 4.1 Bat boxes generally shall be located as shown on Sheet \_\_\_\_\_. Actual field locations shall be approved by the Engineer prior to installation.
- 4.2 Contractor shall provide all labor, equipment, and materials required for fabrication and installation of the bat boxes.
- 4.3 Any variation in design or materials of construction shall be approved by the engineer.
- 4.4 A sample box and mounting pole shall be provided to the engineer for approval. Once approved, the box and pole will be returned to the Contractor.
- 4.5 The Bat Box Schedule is shown on Sheet \_\_\_\_\_.
- 4.6 Typical drawings for the bat boxes are shown on Figure 2.
- 4.7 Pole installation details are shown on Sheet \_\_\_\_\_.
- 4.8 Bat boxes shall be located to provide an obstruction free radius within twenty (20) feet of the box.
- 4.9 Bat boxes shall be located to receive eight (8) full hours of sun.
- 4.10 Contractor shall protect existing vegetation from damage during installation of bat boxes, except as provided in Section 11.

## **5.0 RAPTOR PERCHES**

- 5.1 Raptor Perches generally shall be located as shown on Sheet \_\_\_. Actual field locations shall be approved by the Engineer prior to installation.
- 5.2 Contractor shall provide all labor, equipment, and materials required for fabrication and installation of the raptor perches.
- 5.3 Any variation in design or materials of construction shall be approved by the engineer.
- 5.4 A raptor perch and mounting pole shall be provided to the engineer for approval. Once approved, the perch and pole will be returned to the Contractor.
- 5.5 The Raptor Perch Schedule is shown on Sheet \_\_\_.
- 5.6 Typical drawings for the raptor perches are shown on Figure 8.
- 5.7 Pole installation details are shown on Sheet \_\_\_.
- 5.8 Contractor shall protect existing vegetation from damage during installation of raptor perches, except as provided in Section 11.

## **6.0 BRUSH PILES**

- 6.1 Brush piles generally shall be located as shown on Sheet \_\_\_. Actual field locations shall be approved by the Engineer prior to installation.
- 6.2 Contractor shall provide all labor, equipment, and materials required for installation of the brush piles.
- 6.3 Existing on site deadfall may be used only if other activities included in this project require relocation or removal of existing deadfall. Non-native invasive species removed under Section \_\_\_ may not be used in the construction of brush piles.
- 6.4 Imported brush must be native to the area.
- 6.5 Typical drawings for the brush piles are shown on Sheet \_\_\_.
- 6.6 Brush piles shall be supported by concrete blocks. Bottom layer shall be no more than four (4) inches above the existing ground surface.
- 6.7 Contractor shall protect existing surrounding vegetation from damage during installation of brush piles, except as provided in Section 11.

## **7.0 ROCK PILES**

- 7.1 Rock piles generally shall be located as shown on Sheet \_\_\_. Actual field locations shall be approved by the Engineer prior to installation.
- 7.2 Contractor shall provide all labor, equipment, and materials required for installation of the rock piles.
- 7.3 Existing on site rocks may be used only if other activities included in this project require relocation or removal of existing rocks.
- 7.4 Imported rocks shall be Type B riprap meeting ODOT specification 601.07. Larger rocks shall be placed in the base of the pile.
- 7.5 Rock piles shall be asymmetrical, with average dimensions of ten feet in diameter and four feet in height.
- 7.6 Contractor shall protect existing surrounding vegetation from damage during installation of rock piles, except as provided in Section 11.



## **8.0 WILDFLOWER MEADOWS**

- 8.1 TBD wildflower meadows of approximately # acre each shall be located as shown on Sheet \_\_. The Engineer will field stake meadow boundaries prior to construction. Contractor shall replace stakes lost during planting activities.
- 8.2 Contractor shall provide all labor, equipment, and materials required for construction of the wildflower meadows.
- 8.3 Seed mixtures and application rates are shown on Sheet \_\_.
- 8.4 Immediately prior to seeding, Contractor shall mow existing grasses to a height of no more than three (3) inches.
- 8.5 Contractor shall plant the meadow using no-till drill seeding equipment such as that manufactured by Truax, or an approved equal.
- 8.6 Contractor shall accomplish this work between October 1 and October 15 or between May 1 and May 15.
- 8.7 Contractor shall provide and install signage as shown on Sheet \_\_.
- 8.8 Contractor shall protect existing surrounding vegetation from damage during installation of meadows, except as provided in Section 11.

## **9.0 HUMMINGBIRD GARDEN**

- 9.1 One (1) hummingbird garden of approximately # acre shall be located as shown on Sheet \_\_. The Engineer will field stake garden boundaries prior to construction. Contractor shall replace stakes lost during planting activities.
- 9.2 Contractor shall provide all labor, equipment, and materials required for construction of the hummingbird garden.
- 9.3 Seed mixtures and application rates are shown on Sheet \_\_.
- 9.4 Immediately prior to seeding, Contractor shall import topsoil to raise the garden area approximately TBD feet above existing elevations. Topsoil shall meet ODOT Specification 02200. Side slopes of the raised garden bed shall be 3:1 and stabilized with Type C riprap meeting ODOT specification 601.07.
- 9.5 Contractor shall plant the garden using no-till drill seeding equipment such as that manufactured by Truax, or an approved equal.
- 9.6 Contractor shall accomplish this work between October 1 and October 15 or between May 1 and May 15.
- 9.7 Contractor shall install three (3) free standing sections of treated wood lattice measuring six (6) feet high by twelve (12) feet long as shown on Sheet \_\_. Posts shall be 4"X4"X10' treated lumber and set to a minimum depth of three (3) feet in concrete. Refer to Post Detail on Sheet \_\_.
- 9.8 Contractor shall plant native vine species, per the Planting Schedule on Sheet \_\_, along the entire base of each lattice section.
- 9.9 Contractor shall provide and install signage as shown on Sheet \_\_.
- 9.10 Contractor shall protect existing surrounding vegetation from damage during construction of the hummingbird garden, except as provided in Section 11.

## 10.0 FORESTED ISLANDS

- 10.1 Contractor shall plant forested islands to supplement existing trees and shrubs within the landfill boundaries. The total planting area to be included in new forested islands is approximately \_\_\_\_ acres. Forested islands shall be located as shown on Sheet \_\_\_\_\_. The Engineer will field stake forested island boundaries prior to construction. Contractor shall replace stakes lost during planting activities.
- 10.2 Contractor shall provide all labor, equipment, and materials required for planting of the trees and shrubs.
- 10.3 Trees shall be planted TBD feet apart.
- 10.4 Shrubs shall be planted TBD feet apart, and no closer than TBD feet from any tree.
- 10.5 Trees shall be fifty (50) percent hybrid poplar specie *Populus nigra* x *Populus maximowiczii*, twenty (20) percent common locust (*Robinia pseudoacacia*), ten (10) percent frosted hawthorn (*Crataegus pruinosa*), ten (10) percent northern red oak (*Quercus borealus*), and ten (10) percent red maple (*Acer rubrum*).
- 10.6 Trees shall be unrooted or rooted "poles" at least 10 feet in length planted to a depth of three (3) feet, as shown on Sheet \_\_\_\_\_. The first eighteen (18) inches of depth shall be hand dug or augered to a diameter of two (2) feet. The hole shall be backfilled with amended soils and the pole pushed to a depth of three (3) feet. A pilot hole of the approximate diameter of the pole may be installed using mechanical or manual means.
- 10.7 Shrubs shall be planted to a depth of eighteen (18) inches, unless otherwise approved by the Engineer. The eighteen (18) inches of depth shall be hand dug or augered to a diameter of two (2) feet. The bottom of the hole shall be backfilled with twelve (12) inches of amended soils, the shrub centered in the hole, and the surrounding void backfilled with amended soil.
- 10.8 Shrubs shall be as shown on the Planting Schedule (Sheet \_\_\_\_\_).
- 10.9 Poles shall be maintained in a dormant state prior to planting.
- 10.10 Contractor shall amend tree planting soils as follows:
  - 10.10.1 115 lbs. of slow release 10-20-20 fertilizer per tree
  - 10.10.2 3 lbs. of agricultural lime per tree
  - 10.10.3 5 cubic feet of peat per tree.
- 10.11 Contractor shall amend shrub planting soils as follows.
  - 10.11.1 115 lbs. of slow release 10-20-20 fertilizer per shrub.
  - 10.11.2 3 lbs. of agricultural lime per shrub.
  - 10.11.3 5 cubic feet of peat per shrub.
- 10.12 Contractor shall fully blend amendments with excavated soils used for backfilling. Excess soils may be spread in barren or disturbed areas. Locations must be approved by the Engineer.
- 10.13 Contractor shall accomplish this work between April 1 and June 1 or between October 1 and October 15.
- 10.14 Contractor shall protect existing surrounding vegetation from damage during installation of forested islands, except as provided in Section 11.



## **10.0 HEDGEROW ENHANCEMENT**

- 10.1 Contractor shall plant trees, shrubs and switch grass (*Panicum virgatum*) to expand and enhance existing hedgerows on the northern, western and southern borders of the site, outside the limits of the fill area, as shown on Sheet \_\_. The total planting area to be included in hedgerow enhancement is approximately \_\_\_\_ acres. The Engineer will field stake planting boundaries prior to construction. Contractor shall replace stakes lost during planting activities.
- 10.2 Contractor shall provide all labor, equipment, and materials required for planting of the trees and shrubs.
- 10.3 Trees shall be planted twelve (12) feet apart.
- 10.4 Shrubs shall be planted three (3) feet apart, and no closer than twelve (12) feet from any tree.
- 10.5 Trees shall be thirty (30) percent hybrid poplar specie *Populus nigra* x *Populus maximowiczii*, twenty (20) percent wild black cherry (*Prunus serotina*), ten (10) percent green ash (*Fraxinus pennsylvanic*), five (5) percent smooth or staghorn sumac (*Rhus glabra* or *Rhus typhina*), ten (10) percent northern red oak (*Quercus borealis*), ten (10) percent common hackberry (*Celtis occidentalis*) and fifteen (15) percent shagbark hickory (*Carya ovata*).
- 10.6 Trees shall be saplings at least seven (7) feet in length and planted according to written nursery specifications.
- 10.7 Shrubs shall be as shown on the Planting Schedule (Sheet \_\_).
- 10.8 Shrubs shall be planted according to written nursery specifications.
- 10.9 Contractor shall amend tree and shrub planting soils according to written nursery specifications.
- 10.10 Contractor shall fully blend amendments with excavated soils used for backfilling. Excess soils may be used in construction of the hummingbird garden.
- 10.11 Contractor shall accomplish this work between April 1 and June 1 or between October 1 and October 15.
- 10.12 Contractor shall protect existing surrounding vegetation from damage during installation of forested islands, except as provided in Section 11.

## **11.0 REMOVAL OF INVASIVE SPECIES**

- 11.1 Contractor shall remove invasive species identified and tagged by the Engineer for removal.
- 11.2 Contractor shall provide all labor, equipment, and materials required for removal of invasive species by the methods described below.
- 11.3 Identified and tagged plants with stems one inch in diameter or less shall be dug out if the root depth does not exceed eighteen (18) inches within the limits of the fill area. Plants with depths exceeding eighteen (18) inches within the fill area shall be cut at the target depth and a non-persistent glyphosphate herbicide carefully applied directly to the cut stump or roots according to manufacturer instructions.
- 11.4 Identified and tagged plants with stems greater than one inch in diameter shall be cut at the ground surface and a non-persistent glyphosphate herbicide carefully applied directly to the cut stump according to manufacturer instructions.
- 11.5 Removed invasive species shall be disposed by the Contractor.
- 11.6 Contractor shall accomplish this work between August 15 and October 1.

## **12.0 SITE RESTORATION**

- 12.1 Contractor shall seed all disturbed areas not specifically identified on Sheet \_\_\_\_.
- 12.2 Seed mixture to be used in site restoration shall be at the rate of two (2) lbs / 1000 square feet and shall consist of the following:
  - 60% Brome grass (*Bromus inermis*)
  - 18% Red Clover (*Trifolium pratense*)
  - 22% Perennial Ryegrass (*Lolium perenne*)
- 12.3 Seed shall be fully mixed and evenly sewn by drill seeding
- 12.4 Mulching materials shall conform to ODOT Specification 659.06. Application rates shall be two (2) tons per acre for straw or three (3) tons per acre for hay.
- 12.5 Contractor shall seed using no-till drill seeding equipment.
- 12.6 Fertilizing, liming and watering shall be per the seed manufacturer instructions.

## **13.0 SITE MAINTENANCE**

- 13.1 Contractor shall be responsible for watering and maintenance of vegetation from the time of planting through three months following the completion of final site restoration.
- 13.2 During this maintenance period, Contractor shall reseed areas as required by the Engineer.

# IEL HABITAT ENHANCEMENT PROJECT

PHYSICAL STRUCTURES SCHEDULE			
Symbol	Description	Quantity	Figure #
A	Bird Nesting Box	0-20	4, 5, 7
B	Fox Den	0-2	6
C	Bat Box	0-6	2, 3
D	Raptor Perch	0-6	8
E	Brush Pile	0-10	TBD
F	Rock Pile	0-8	TBD

PLANTING SCHEDULE			
Symbol	Description / Species	Quantity	Ref. Detail / Sheet #
FI	Forested Islands		
	<i>Hybrid Poplar Tree</i>	0-1000	Detail FI-1 / 3
	<i>Common Locust Tree</i>	0-400	Detail FI-2 / 3
	<i>Frosted Hawthorn Tree</i>	0-200	Detail FI-2 / 3
	<i>Northern Red Oak Tree</i>	0-200	Detail FI-2 / 3
	<i>Red Maple Tree</i>	0-200	Detail FI-2 / 3
	Total (based on median ea.)	1000	
HE	Hedgerow Enhancement		
	<i>Hybrid Poplar Tree</i>	0-100	Detail FI-1 / 3
	<i>Wild Black Cherry Tree</i>	0-70	Detail FI-2 / 3
	<i>Green Ash Tree</i>	0-30	Detail FI-2 / 3
	<i>Sumac Tree</i>	0-20	Detail FI-2 / 3
	<i>Northern Red Oak Tree</i>	0-30	Detail FI-2 / 3
	<i>Common Hackberry Tree</i>	0-30	Detail FI-2 / 3
	<i>Shagbark Hickory Tree</i>	0-50	Detail FI-2 / 3
	<i>Jerseytea Shrub</i>	0-120	Detail HE-1 / 3
	<i>Common Buttonbush Shrub</i>	0-120	Detail HE-1 / 3
	<i>Blackcap Raspberry Shrub</i>	0-120	Detail HE-1 / 3
	Total (based on median ea.)	345	
SG	Switch Grass	lb/ac.	NA



# IEL HABITAT ENHANCEMENT PROJECT

## LIST OF DRAWINGS

Sheet No.	Title	Contents
1	Title Sheet	<ul style="list-style-type: none"><li>□ Project Title</li><li>□ Site Location Map</li><li>□ Project Area Map</li></ul>
2	Site Plan	<ul style="list-style-type: none"><li>□ Planting Areas Boundaries</li><li>□ Structure Locations</li><li>□ Existing Vegetative Cover</li><li>□ Existing Topography</li><li>□ Existing Fence Location</li><li>□ Limits of Waste Delineation</li><li>□ Contractor Staging Area Location</li></ul>
3	Details	<ul style="list-style-type: none"><li>□ Physical Structure Details (Figures 2-8)</li><li>□ Excavation/Planting Details (Figures TBD)</li><li>□ Hummingbird Garden Crossection (Figure TBD)</li></ul>
4	Schedules and General Plan Notes	<ul style="list-style-type: none"><li>□ Physical Structures Schedule</li><li>□ Planting Schedule</li><li>□ General Plan Notes</li></ul>

# **IEL HABITAT ENHANCEMENT PROJECT**

## **MONITORING AND MAINTENANCE PLAN OUTLINE**

- 1.0 Introduction and Purpose
- 2.0 Site Location and History
- 3.0 Precautions
  - 3.1 excavation during maintenance
  - 3.2 invasive species removal methods
  - 3.3 replanting methods
  - 3.4 consumption of vegetative yields from within site boundaries
  - 3.5 fence maintenance
  - 3.6 removal of materials from within the site boundary
- 4.0 Health and Safety
  - 4.1 Overview of issues of concern
  - 4.2 Applicable OSHA requirements
  - 4.3 Emergency contacts
  - 4.4 Reference / location of Project Health and Safety Plan
- 5.0 Monitoring
  - 5.1 Nest monitoring procedures and frequency
  - 5.2 Invasive species monitoring procedures and frequency
  - 5.3 Species diversity inventory procedures and frequency
  - 5.4 Vegetative growth and cover monitoring procedures and frequency
- 6.0 Maintenance
  - 6.1 Mowing schedules by area and sub area
  - 6.2 Replanting / restoration criteria
  - 6.3 Nest / physical structures maintenance procedures and frequency
- 7.0 Reporting
  - 7.1 Responsibilities
  - 7.2 Frequencies
  - 7.3 Contents

Table 1. Summary of WHC Recommendations for IEL Site

Nest Monitoring Program

- ☐ European starlings and English house sparrows to be eliminated if compete for boxes
- ☐ Nests should removed after eggs hatch and boxes checked for parasites
- ☐ Target species are eastern bluebird, tree swallow, American kestrel

Eastern Bluebird

- ☐ Like open field habitats and tight spots of way with scattered trees
- ☐ Diet on insects in summer and berries and seeds in winter
- ☐ Place nesting boxes along trails in grassy open areas
- ☐ See box design in Appendix F of Eastern Bluebird Habitat Management Leaflet (get further spec reference)
- ☐ Install cone shaped predator guards as shown in same appendix

Tree Swallow

- ☐ Can use same box as Eastern Bluebird
- ☐ Place boxes near Metzger Ditch to assist in insect control
- ☐ Like boxes in open areas
- ☐ Can use paired boxes for both species since do not compete with each other
- ☐ See Tree Swallow Habitat Management Leaflet in Appendix F

American Kestrel

- ☐ Feed on mice, lizards, and large insects
- ☐ Can be attracted to nest boxes
- ☐ Must monitor from afar because Kestrels sensitive to humans
- ☐ Place boxes in open areas, near brush or forest edges
- ☐ Do not place near songbird boxes as Kestrels could feed on them
- ☐ See American Kestrel Habitat Management in Appendix F

Red Fox

- ☐ Carnivorous but also eat berries & nuts
- ☐ Use dens during breeding season (March to June)
- ☐ Dens near water sources and have two entrances
- ☐ Dens not near human activity
- ☐ Install near center of property or along the hedgerow areas
- ☐ Site will only support 1 breeding pair
- ☐ Home ranges is 250 ha.
- ☐ Foxes use multiple dens so create 2
- ☐ See drawing on page 18 - VIP
- ☐ Stabilize tunnel entrances with vegetation

Wildflower Meadow

- ☐ Increases diversity
- ☐ Develop 1 acre test plots to determine which species will best survive
- ☐ Plant in grassy meadow to right of entrance gates
- ☐ Will make positive aesthetic impression on visitors
- ☐ *Planting Area Preparation*
  - ☐ Drill seed into existing vegetation
  - ☐ First mow area to height of 3 inches to limit initial competition from grasses
  - ☐ Use no-till seed drill such as Truax



- Plant in May, following mowing or as second choice, early October
- Truax drills sew into existing veg without requiring disturbance of the soil
- Seed rate should be 12 to 20 lbs / acre for meadow grass/forb mixtures
- Keep wildflower seeds and grass seeds separate in different compartments of the seeder to ensure proper dispersion
- Place signage to prevent mowing
- *Seed mixes*
  - See Table 2
  - Use high percentage of perennials
  - Mix in some annuals for color
  - Need to check table 2 to see what is native to Ohio
  - Shannon researching the species in table 2 native to Ohio
- *Maintenance of wildflower meadow*
  - Mow to 6 inch height from spring to fall of first year
  - Plants focus energy in first year on root growth rather than flowering
  - Yearly mowing or burning program after first year
  - Mow in second year in late winter or early spring, before nesting season of ground species
  - After second year, mow ½ per year
  - See Meadow Management Habitat Management in Appendix F

#### Bat

- Can use manmade bat boxes if properly constructed
- Place on posts or in trees 15-30 feet above the ground
- Clear of obstacles for 20 foot radius
- Place in open areas around the lagoon
- Box must receive 8 full hours of sun
- Paint inside black to increase temperature
- Place at least ¼ mile from water
- Move boxes after two years if bats not moved in
- See North American Bat Conservation Habitat Management Series in Appendix F

#### Field Border Management

- *Rotational Mowing*
  - Mow in sections in alternate years, like the wildflower meadow
  - See Figure 4 for layout
  - Mow every three years
  - Do not mow in May through September due to nesting
- *Enhance Hedgerow*
  - Plant trees and shrubs to widen the hedgerows
  - Plant switch grass bordering the hedgerow
  - See Table 3

#### Forested Islands

- Center of IEL is in early stages of succession to forest
- Tall poplars on site
- Use species that produce fruit or hard mast (oaks & hickories)
- Plant seedlings / saplings in early spring
- Plant what is listed in Table 3
- See Figure 5
- Plant trees 12 feet apart

- ❑ Plant shrubs 3 feet apart

#### Hummingbird Garden

- ❑ Use wildflower species from Table 2
- ❑ Construct on a raised bed
- ❑ Supplement watering may be needed
- ❑ Plant near entrance
- ❑ May want to have free standing fence for vines to climb so do not damage actual gate
- ❑ Plant vines on fence. They benefit hummingbirds by providing cover from predators
- ❑ See table 4 for vine species

#### Manage for balanced predator / prey population

- ❑ Build brush piles to provide cover for prey
  - Brush pile has two parts – base and top
  - Build bottom with larger, weather resistant logs
  - Lay on cedar blocks to reduce rot
  - Keep base logs no higher than 4 inches off ground
  - Stack in log house design
  - Cover top with twigs and brushy branches
  - Build along grassy paths
  - See fig 5 and Appendix F
- ❑ Build Rock Piles
  - Use rocks larger than 30 cm
  - Place larger along foundation
  - Do not create symmetrical pile
  - Construct multiple piles rather than one large one
  - Place in open areas near lagoon
- ❑ Build raptor perches for avian predators
  - See Figure 7
  - Serve kestrels, red-tailed hawks and broad winged hawks
  - Place in open areas

#### Control Invasive Species

- ❑ Observed invasive species include:
  - Phragmites, autumn olive, sumacs
- ❑ Dig out and physically remove smaller plants
- ❑ Use herbicide (glyphosate) on larger stumps after cut
  - Use herbicide in late fall



2101-Substation.dwg 2101-Substation.dwg

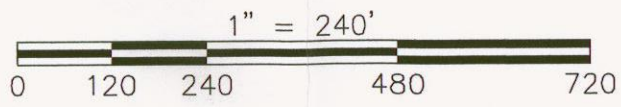


**LEGEND**

- MONITORING WELL & NUMBER  
s =SHALLOW WELL  
i =INTERMEDIATE WELL  
d =DEEP WELL
- SITE BOUNDARY
- FENCE
- EXISTING FORESTED AREAS
- EXISTING GRASSLAND
- HEDGEROW ENHANCEMENT
- HARDWOODS, NUTS, & BERRIES
- WILDFLOWER AREA
- SWITCH GRASS
- HUMMINGBIRD AREA
- WETLAND
- EMERGING FORESTED ISLANDS

RECHANNELIZED  
METZGER  
DITCH

50 HUB



Project Reference: 2101

IEL SITE  
FUTURE ECOLOGICAL  
REGIMES

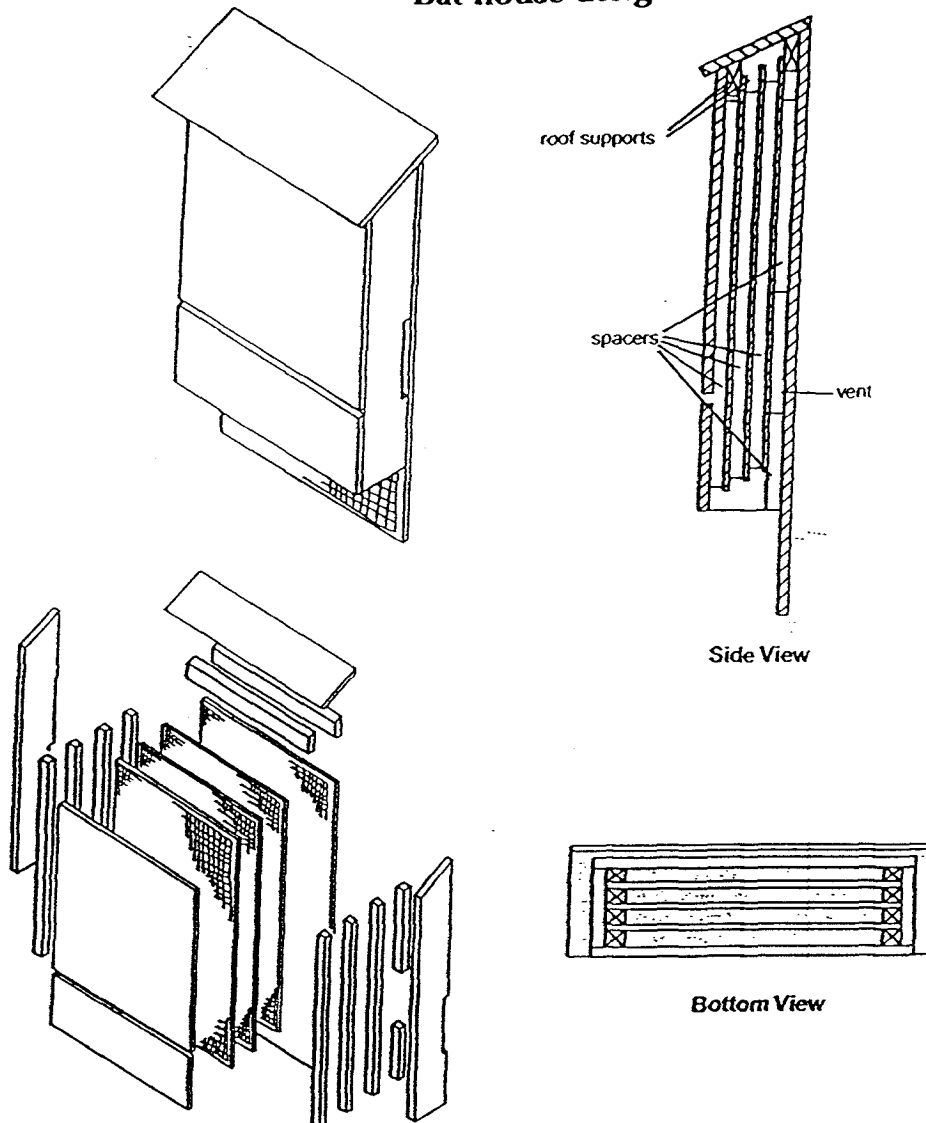
FIGURE 1

**SHARP**  
AND ASSOCIATES, INC.  
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COLUMBUS, OHIO 43229  
(614) 841-4650 / FAX (614) 841-4660

Client: IEL PRP GROUP



## Bat house design



1. Measure and mark all wood as per cutting diagrams on page seven. Cut out all parts.
  2. Cut six pieces of netting 14" x 21". Staple to partitions.
  3. Screw back to sides, caulking first. Be sure top angles match.
  4. Cut a piece of netting 16" x 30" and staple to inside surface of back. Be sure netting lies flat and does not pucker.
  5. Construct house as per drawings above. Place spacers on partitions, screw top front piece to sides first then screw bottom front piece to sides to create a 1/2" vent between the two, attach roof supports, attach roof.
  6. Caulk between roof and sides, sides and front pieces, and sides and back piece so as to seal house airtight. Do not allow screws to protrude into roosting chamber. Paint exterior at least twice with appropriate color.
- (Excerpted from *The Bat House Builder's Handbook*, 1997 Revision. ©1993 Bat Conservation International. Used with permission.)

Source: Wildlife Habitat Council

**SHARP**  
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505 CHERRY AVE.  
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## ARTIFICIAL NESTING STRUCTURES

PROJECT NUMBER  
2101

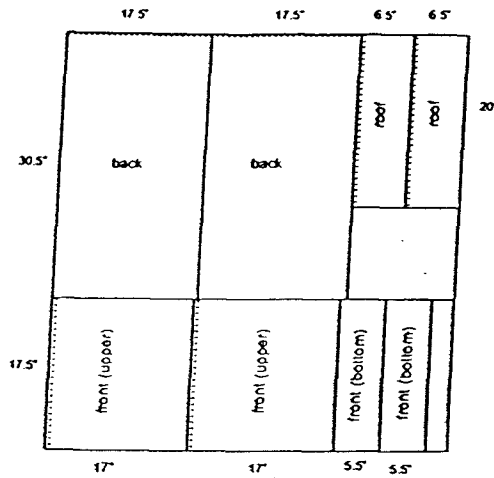
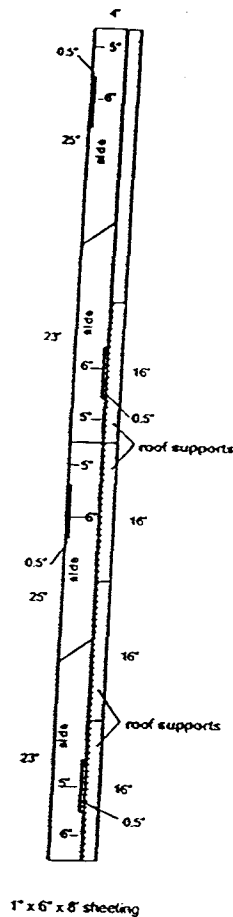
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8/26/03

FILE NAME  
2101-F2

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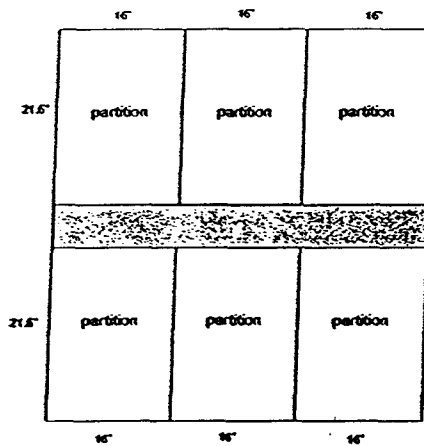
FIGURE  
2

# Nursery house sawing diagrams



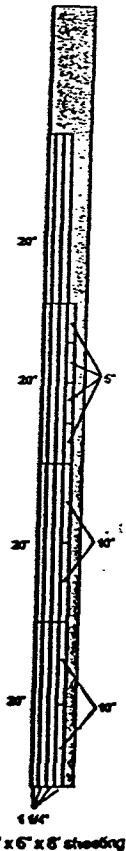
4' x 4' x 1/2" plywood

extra material  
25 degree bevel



4' x 4' x 1/4" plywood

3 pieces:  
5" spacers = back bottom  
10" spacers = back top  
20" spacers = others



Source: Wildlife Habitat Council

**SHARP**  
AND ASSOCIATES, INC.  
200 CHERRY AVE.  
CHILMARK, MASS 01915  
508/455-0000

## ARTIFICIAL NESTING STRUCTURES

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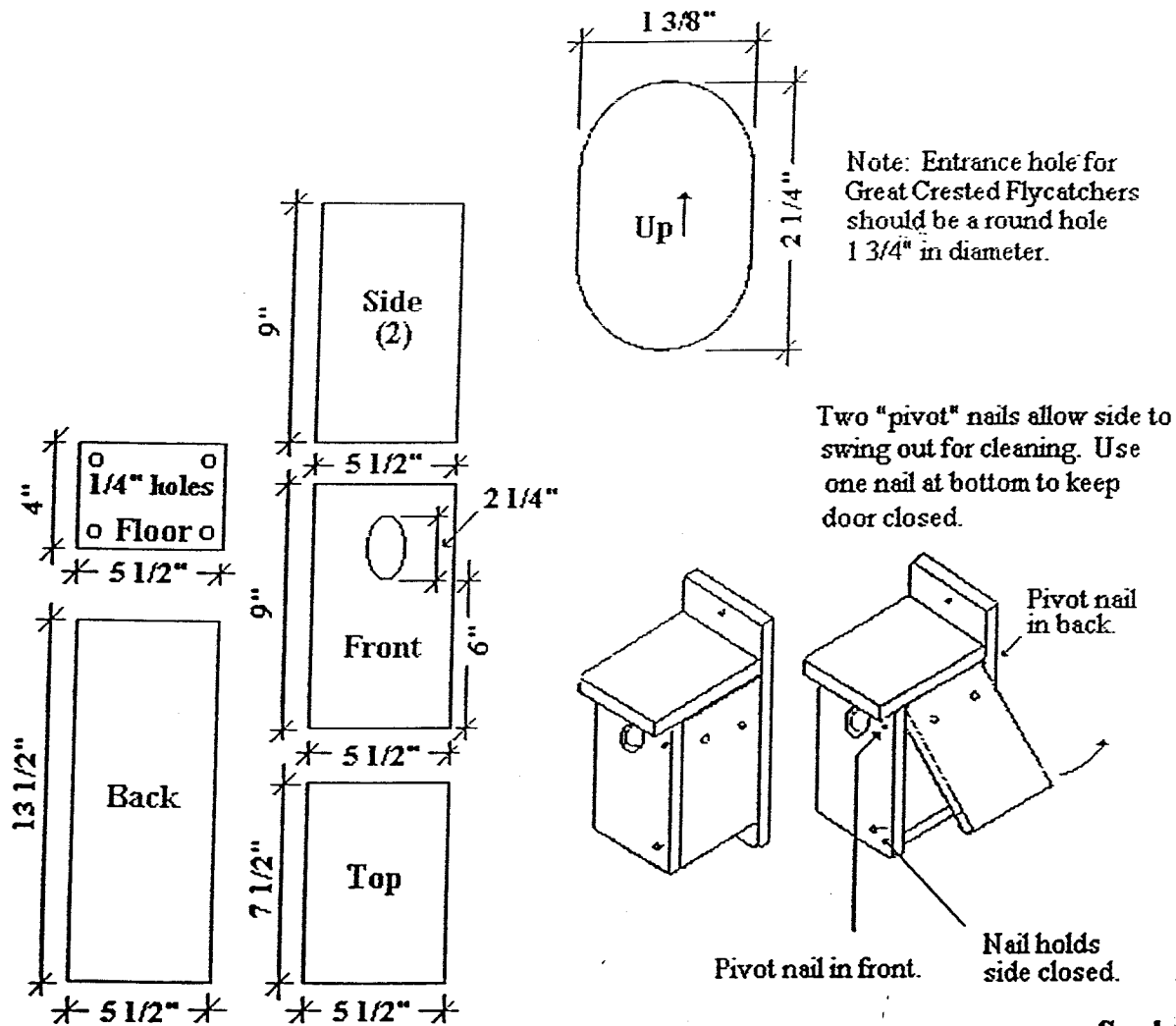
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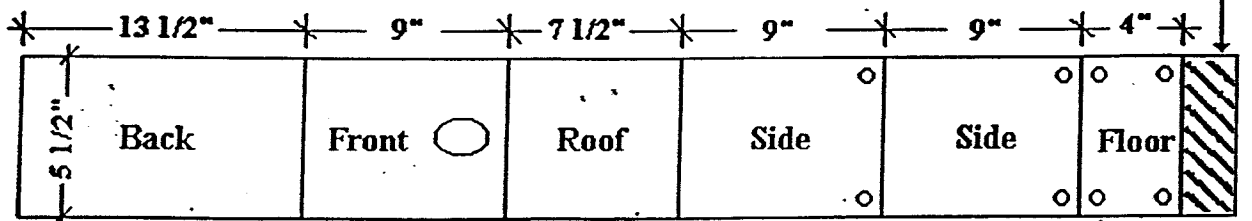
FIGURE  
3

## Tree Swallow and Eastern Bluebird

Eastern bluebirds nest throughout North Dakota. The best habitat consists of areas comprised of short grasses with nearby fence posts, high line wires, or sparse trees where birds can perch. Bluebirds normally will not nest within city limits or farmsteads where competition from house sparrows is intense. For best results, nest boxes should be placed in pairs about 10-25 feet apart and 100-200 yards between pairs. They should be put 4-6 feet above the ground on steel posts or wood posts with predator guards. The entrance hole should face in a general northeast direction to prevent sun from shining in and over-heating the box.



Lumber: One 1" x 6" x 6'



Source: Wildlife Habitat Council

**SHARP**  
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### ARTIFICIAL NESTING STRUCTURES

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2101

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8/26/03

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2101-F4

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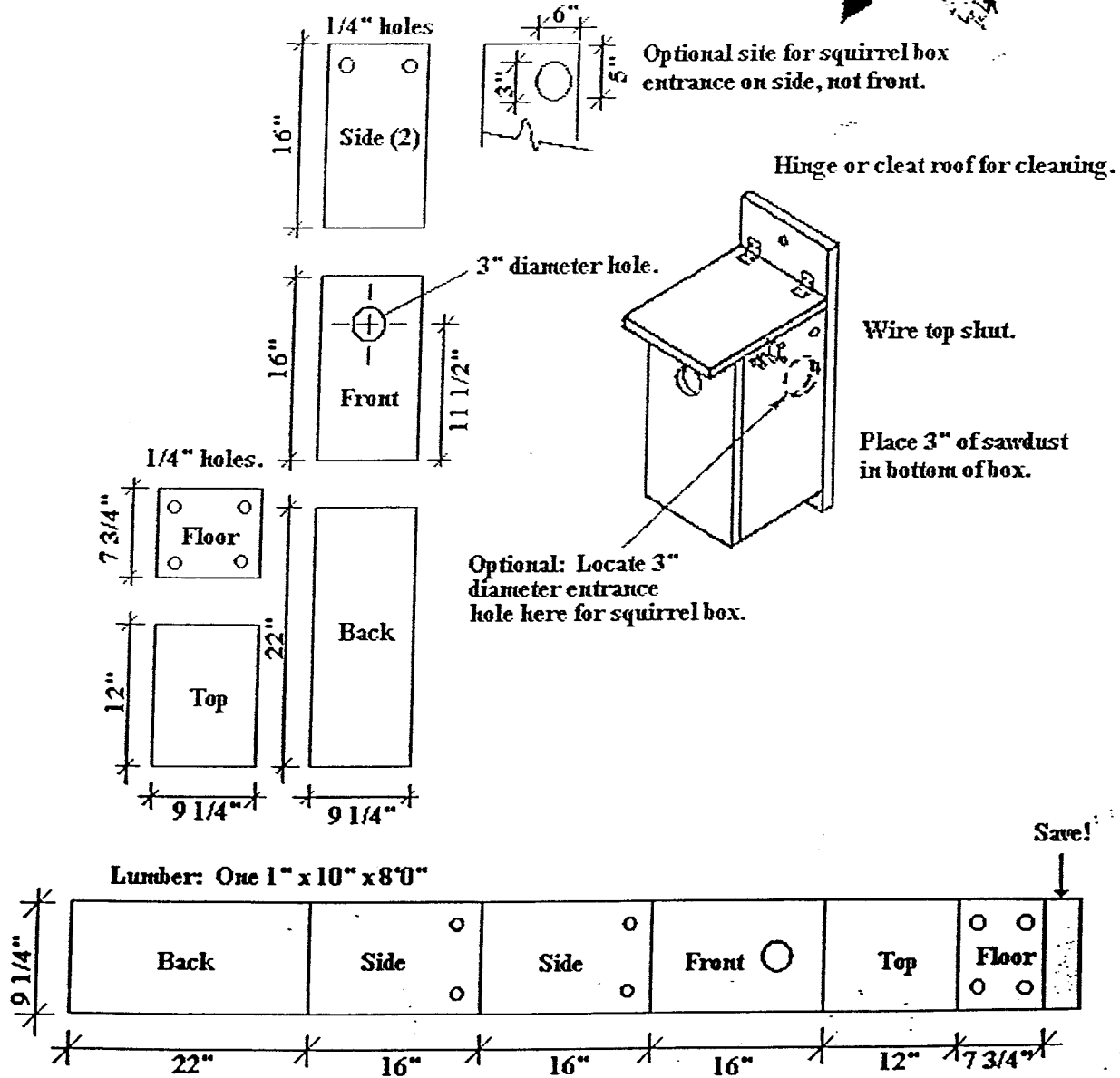
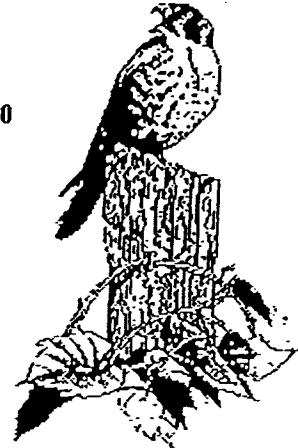
FIGURE

4



# American Kestrel, Northern Screech-owl, Gray Squirrel, Red Squirrel, and Fox Squirrel Nest Box

To attract kestrels, place the box in relatively open country on a tree or post 10-30 feet high with grassy habitat nearby. Screech-owls can be attracted along the edges of hardwood forests adjacent to fields or wetlands. Boxes should be placed at least 10 feet high. Both the kestrel and owl boxes should include a predator guard to keep squirrels from using the nest boxes. Squirrels can be attracted by using this box and filling it half full of leaves and mounting at least 30 feet above the ground on a tree at least 10 inches in diameter. It is not necessary to clean out squirrel boxes.

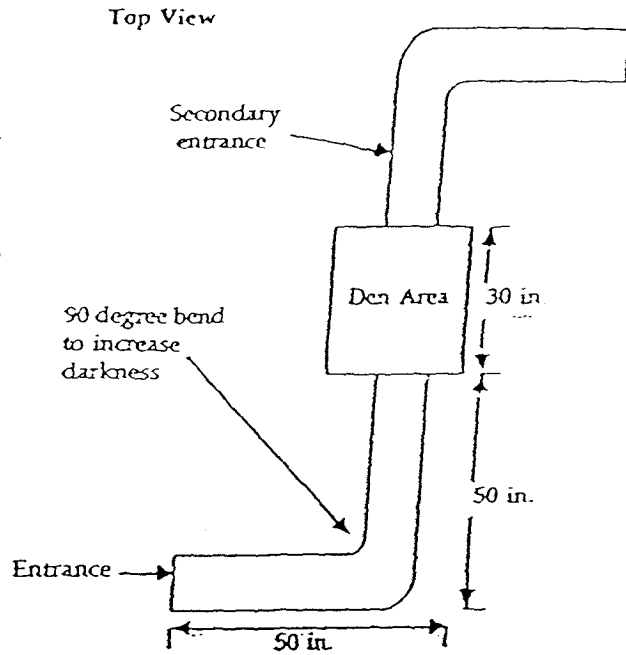


Source: Wildlife Habitat Council

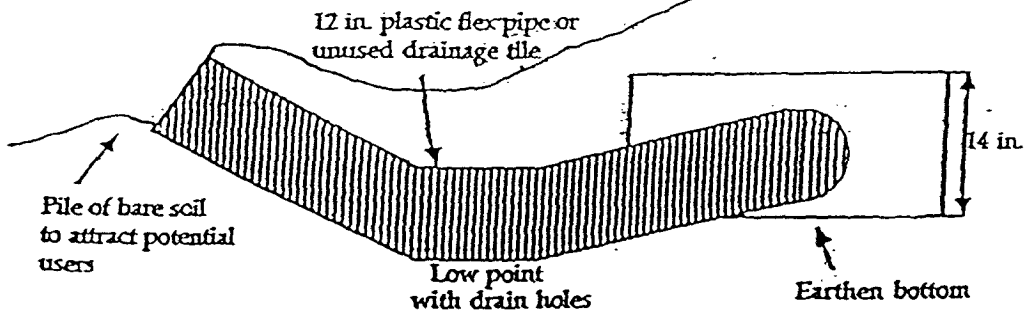
# Artificial Fox Den

## Construction Notes:

- Tunnels made of 12" plastic flex pipe or unused drainage tile
- Den made of 1/4" plywood (no bottom)
- Top may be removable for cleaning
- Den area should be higher than tunnels to facilitate drainage



## Side View (excluding second entrance)



- For safety, if a removable top is installed, the den should only be opened when the den is not occupied.

Source: Wildlife Habitat Council

**SHARP**  
AND ASSOCIATES, INC.  
DESIGNERS AND  
CONSULTANTS  
FOR THE WILDLIFE HABITAT COUNCIL

## ARTIFICIAL NESTING STRUCTURES

PROJECT NUMBER  
2101

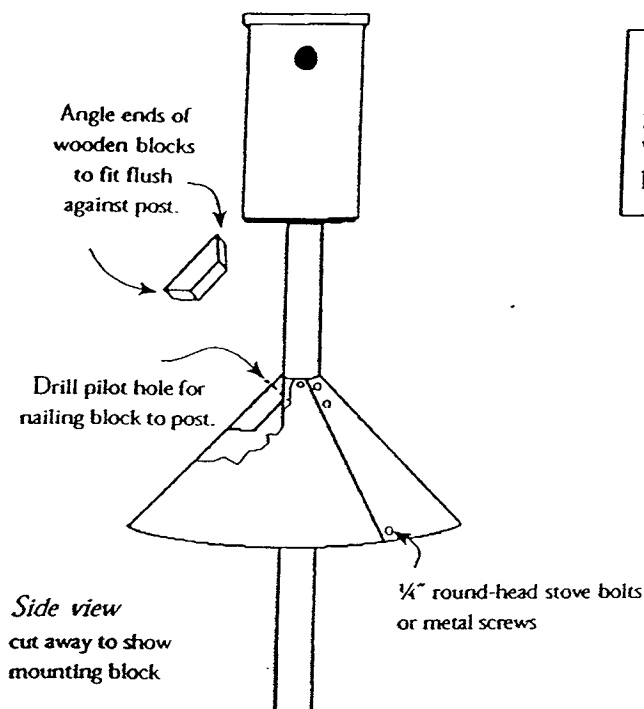
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FILE NAME  
2101-F6

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FIGURE  
6

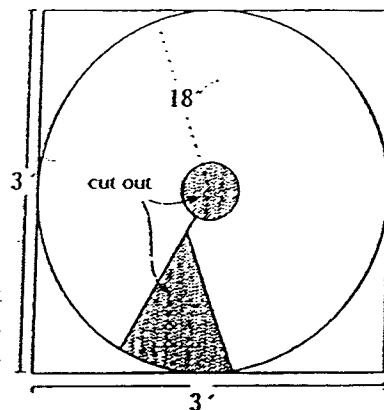
## A Plan for a Conical Predator Guard



### Materials List

24- or 26-gauge galvanized sheet metal ..... 3' x 3'  
 Wood mounting blocks (3) ..... 4" x 1 1/2" x 1 1/2"  
 Hardware ..... 1/4" round-head stove bolts or metal screws

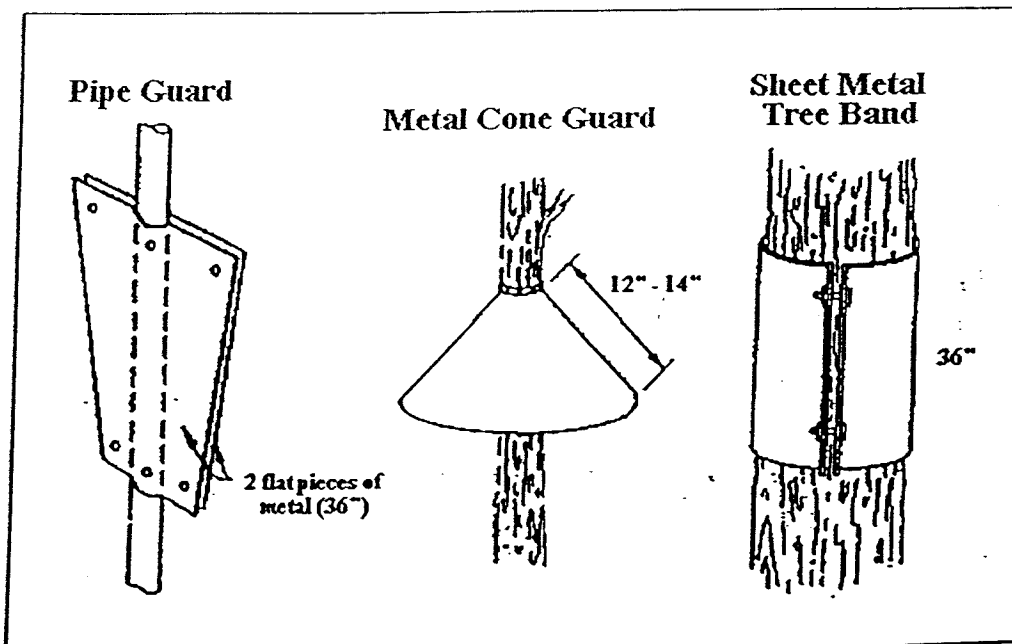
5" hole fits 4" post  
 6" hole fits 5" post  
 7 1/4" hole fits 6" post



Cut predator guard from a 3' x 3' piece of 24- or 26-gauge galvanized sheet metal. Join sides with 1/4" round-head stove bolts or metal screws. Use angled wooden blocks to nail guard in place.

Printed with permission from *Bluebirds Forever* (Toops 1994)

Plans adapted from designs by the U.S. Fish & Wildlife Service and from *The Bluebird: How You Can Help Its Fight For Survival* (Zeleny 1976)



Source: Wildlife Habitat Council

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## ARTIFICIAL NESTING STRUCTURES

PROJECT NUMBER  
2101

DATE  
8/26/03

FILE NAME  
2101-F7

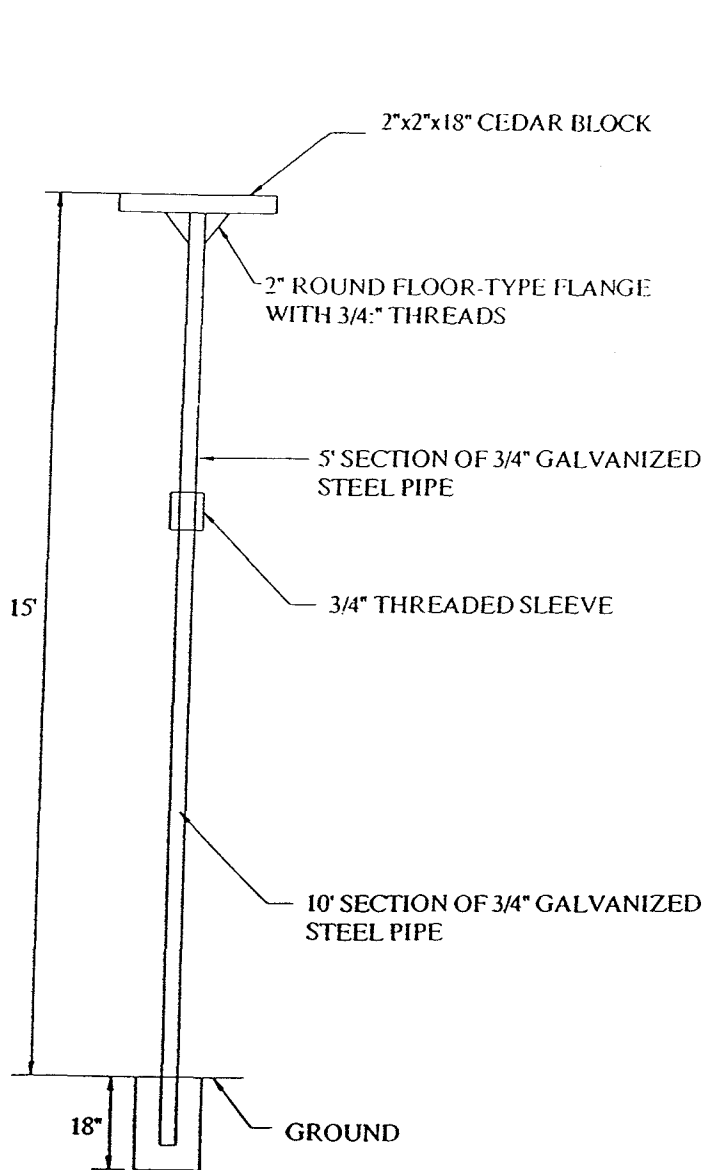
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FIGURE

7

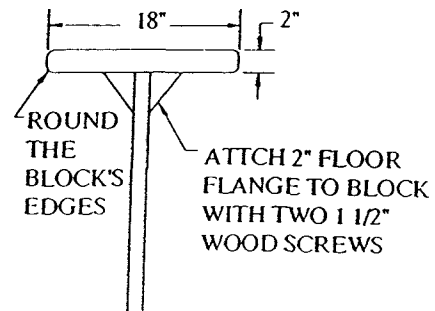


# DIAGRAM OF RAPTOR PERCH CONSTRUCTION



CREATE A 18" DEEP x 15" WIDE HOLE AND THEN FILL WITH AND APPROPRIATE AMOUNT OF READY MIX CONCRETE

Source: The Wildlife Society Volume 2. Number 4, Winter 1991 pages 293-298



BLOCK DETAIL

## MATERIALS:

- A. TWO 10' SECTIONS OF GALVANIZED STEEL PIPE, 3/4" DIAMETER.
- B. ONE 2"x2"x18" CEDAR BLOCK
- C. TWO 1 1/2" WOOD SCREWS
- D. ONE CUBIC FOOT READY MIX CONCRETE
- E. ONE 2"x3/4" FLOOR FLANGE
- F. ONE 3/4" THREADED SLEEVE
- G. RUST PREVENTIVE PAINT FOR PIPES AND WATER TREATMENT FINISH FOR WOOD

## NOTES:

1. COAT ALL OF THE ABOVE GROUND STEEL WITH RUST PREVENTIVE PAINT AND ALL EXPOSED WOOD WITH THE WATER TREATMENT FINISH.
2. MIX THE CONCRETE AS RECOMMENDED BY THE MANUFACTURER.